

Landbird Inventory of the National Parks of the San Francisco Bay Area

FINAL REPORT

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**A report to the Point Reyes National Seashore
and the Golden Gate National Recreation Area**

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EXECUTIVE SUMMARY

Biologists from the Point Reyes Bird Observatory conducted an inventory of the birds of the San Francisco Bay area national parks during the breeding seasons of 1999 and 2000. As part of this inventory we analyzed data from 61 transects totaling 697 point count stations, many of which were selected by stratified random sampling, within the Point Reyes National Seashore (PORE), the Golden Gate National Recreation Area (GOGA) including the Presidio of San Francisco. Data were collected at 273 of these stations in 1998, prior to the inventory, as part of separate monitoring contracts with PORE and GOGA, and were included in the inventory analysis as many habitats and regions had already been covered. Habitats were assessed at the alliance level. Point count stations were established in 23 defined habitat alliances, with sufficient sample sizes of points within the 13 most abundant habitats in which it was possible to establish that many points. The goal of censusing approximately 80 to 90% of the landbird species breeding in the park was assessed after the inventory was completed by analyzing the rate at which new species were added as additional points were established, and coverage was deemed sufficient.

A variety of population parameters for each habitat were obtained with the point count data, including bird diversity, species richness, and relative abundance. Relative abundance was determined within each habitat for the entire avian community as well as individually for each of 71 species. The parks support large numbers of many resident or short-distant migrant species, including Song Sparrow (the most abundant), Anna's Hummingbird, Bewick's Wren, Chestnut-backed Chickadee, Purple Finch, Spotted Towhee, Winter Wren, and Wrentit. A number of Neotropical migrant species were relatively common throughout the parks as well, including Allen's Hummingbird, Orange-crowned Warbler, Pacific-slope Flycatcher, Swainson's Thrush, and Wilson's Warbler. A number of less common species were detected fairly locally or in small numbers, including Black-throated Gray Warbler, California Thrasher, Hermit Warbler, Lark Sparrow, Northern Mockingbird, Oak Titmouse, Rufous-crowned Sparrow, Western Meadowlark, and Yellow Warbler. We found high bird population indices in bishop pine, Douglas fir, red alder, and willow habitats.

A GIS database, which includes all the bird data collected as part of this project, accompanies this report as a supplement. This database enables users to generate maps for all species across

the 697 census stations, and to examine population parameters throughout the park. Associated vegetation databases are also included that can be used to further evaluate park vegetation maps.

INTRODUCTION

A number of national parks are located in the San Francisco Bay area, including the Golden Gate National Recreation Area (GOGA), the Point Reyes National Seashore (PORE), and the Presidio. Together these parks, consisting of 160,000 acres of land, share physical boundaries, habitats and wildlife, and important ecological issues.

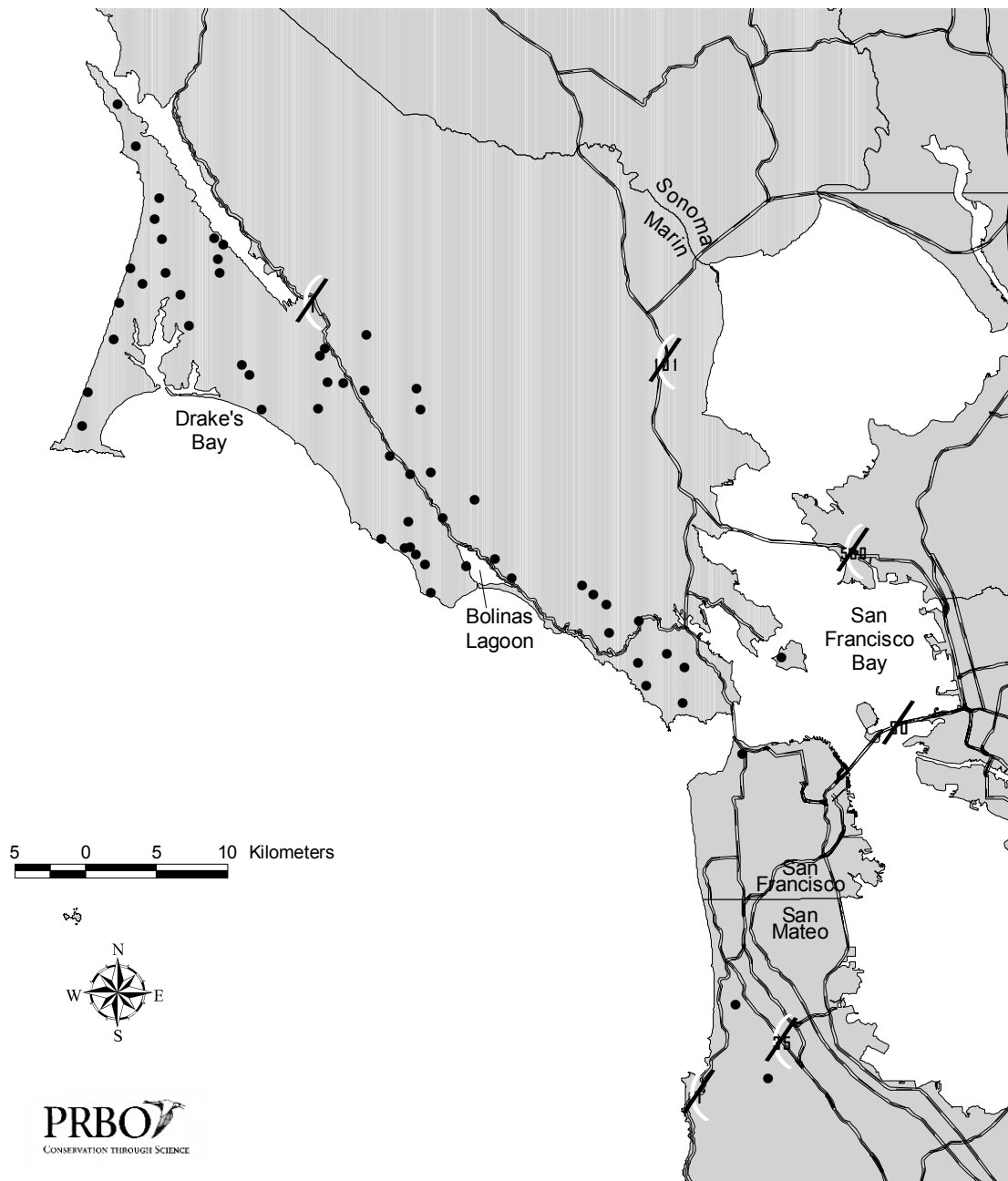
The diversity and abundance of avifauna of these parks is extraordinary. Much data has been collected on birds in this region, including more than 35 continuous years of landbird data collected by the Point Reyes Bird Observatory (PRBO) in collaboration with the National Park Service. Only recently have systematic and coordinated surveys been conducted throughout the bay area parks.

During a scoping session in 1996, the national parks identified avifauna as a major component of ecosystems to be inventoried and monitored. In 1999 PRBO, in collaboration with GOGA and PORE, began a two-year landbird inventory of these national parks, establishing approximately 400 new point count stations and using data from nearly 300 stations collected in 1998 (Fig. 1). This inventory covered all major habitats (at the alliance level) within the parks and was designed to provide information on distribution, abundance, species richness, diversity, and habitat associations of landbirds breeding within the parks (Nur et al. 1999). Habitats were described according to the current California classification system of dominant plant alliances (Sawyer and Keeler-Wolf 1995). Results from a waterbird and shorebird inventory conducted during the 1998/1999 winter were presented in a separate PRBO document (White 1999).

Goals of this project included (1) to document distribution, relative abundance, species richness and diversity of breeding landbirds in the major habitat types, (2) to document approximately 80% (and preferably 90%) of breeding landbird species in the parks and describe their habitat associations in the parks, (3) to provide a database for the development of distribution maps of the landbird species breeding in the parks and (4) to provide recommendations for a conceptual long-term monitoring plan for breeding landbirds in the parks.

A supplement to this report (Supplement A) exists on CD and contains the GIS database for these point count locations, all associated bird database files necessary for generating species distribution maps, and all vegetation data associated with this project that can be used to further evaluate park vegetation maps.

Figure 1. San Francisco Bay Area National Parks Inventory Sites



METHODS

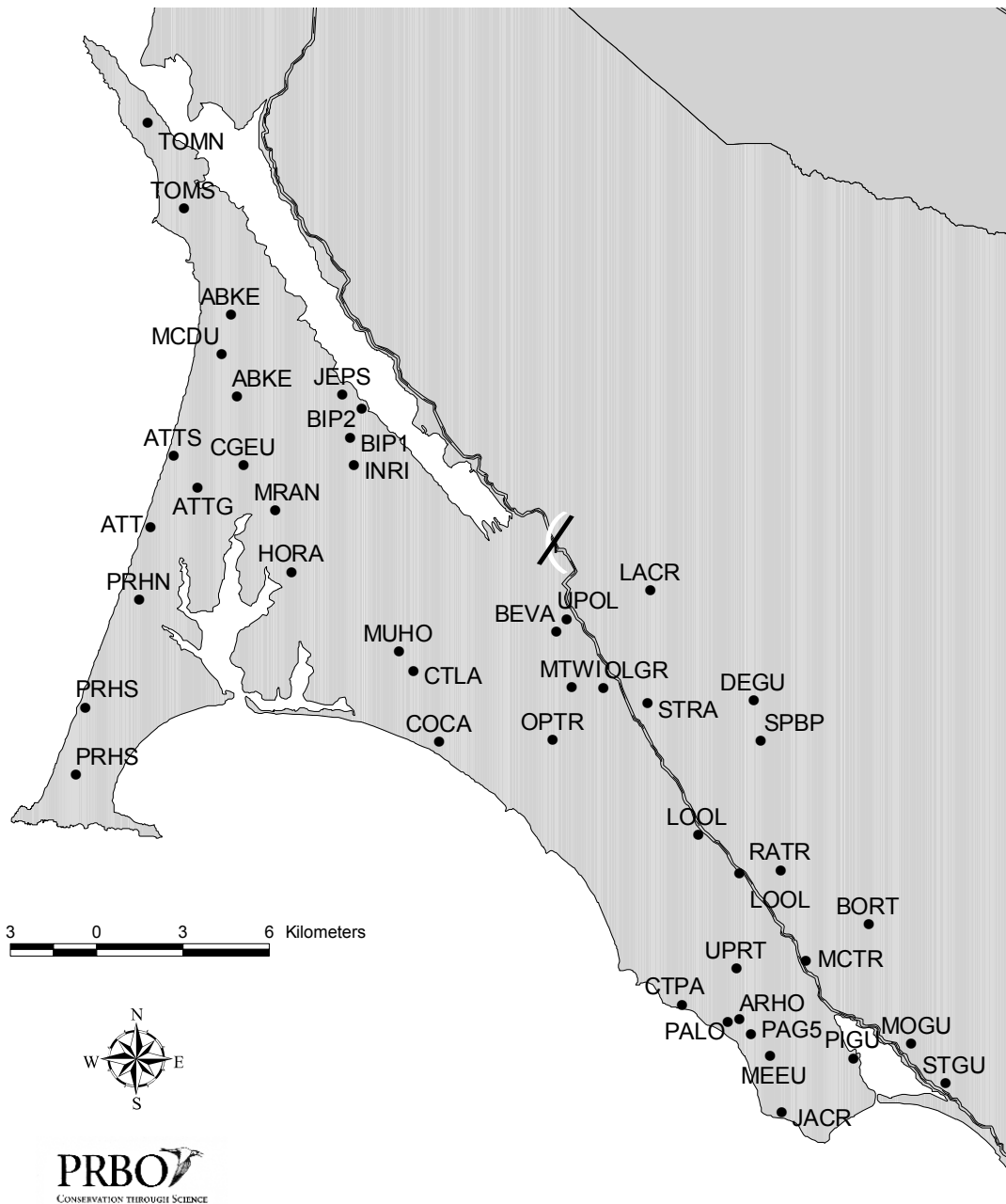
POINT COUNT CENSUS

Standardized fixed-radius point count censuses were conducted to inventory landbirds of the parks, as described in Ralph et al. (1993, 1995). Transects were established which consisted of multiple point count census stations, spaced 200-250 m apart. At each station a five-minute, 50 meter, fixed-radius census was conducted. All birds detected within a five-minute period at each station were recorded, with separate categories for those detected within a radius of 50 m surrounding the census point, those detected greater than 50 m from the point, and those flying over the census area but not observed landing. The type of detection (song, visual or call) was also noted, in that hierarchical order. Counts began within 30 minutes of local sunrise and continued for no more than four hours in order to restrict the census to peak singing hours. Counts were not conducted during poor weather conditions, when bird activity levels or abilities of observers to detect birds are reduced. Censuses were conducted between late April and early July with a minimum of 10 days between visits to increase detection probabilities of less common species. All transects were censused three times, except Angel Island and Home Ranch which were censused one and two times respectively (Appendix A).

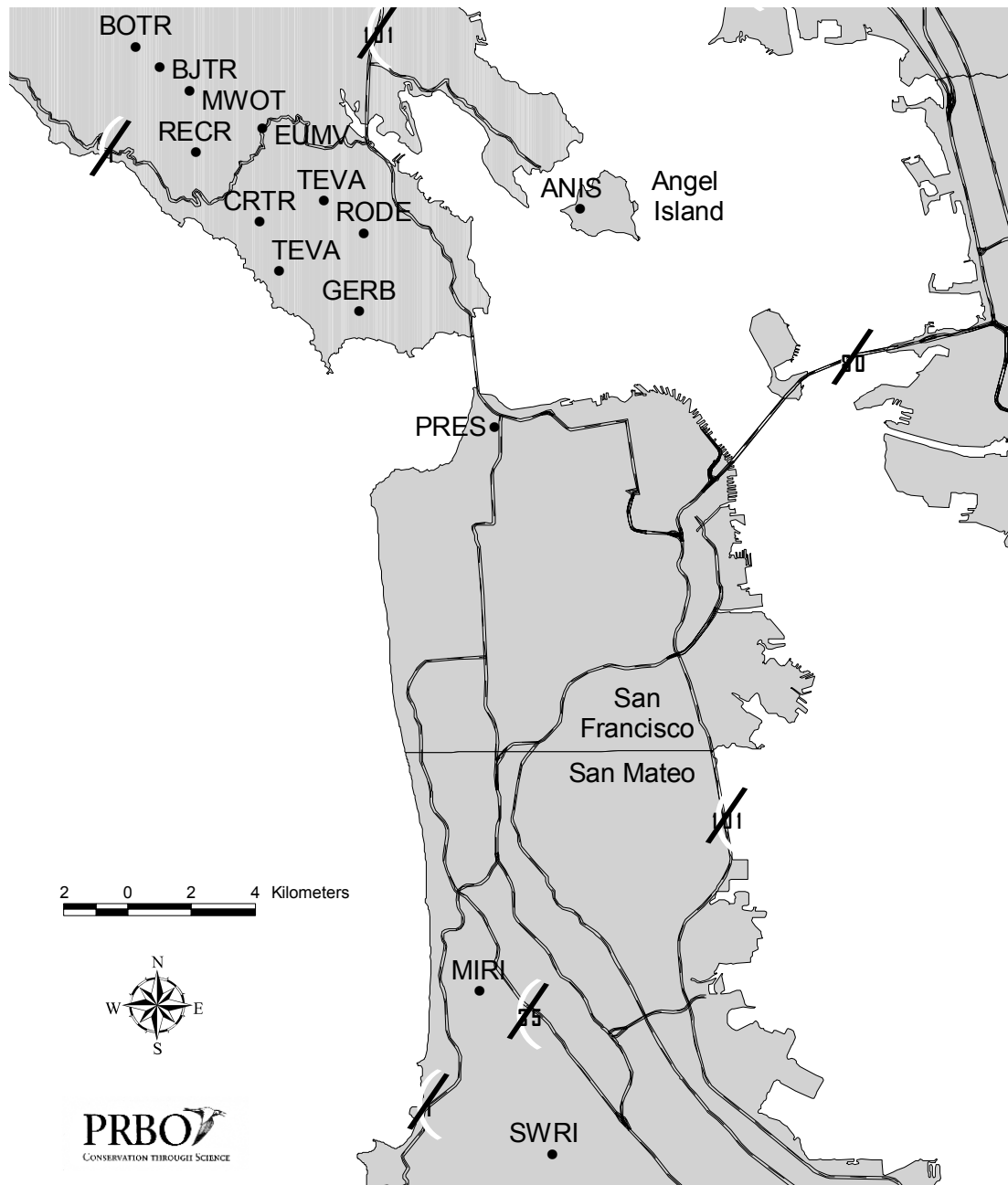
SELECTION OF STUDY SITES

A total of 697 point count stations were used in this inventory project (Figures 1, 2 and 3), many selected with modified stratified random sampling. During the 1999 and 2000 breeding seasons, 36 new transects consisting of 357 point count census stations were established in the parks. Six additional transects (67 point count census stations) that had been surveyed by PRBO in previous years were repeated in 1999 or 2000 as part of the inventory. Data from 19 transects (273 point count stations) within PORE and GOGA that were censused by PRBO in 1998 under separate contracts are included in this report (Holmes et al. 1999). Point count stations were placed at least 50m from paved roads, and most routes made use of existing trails. Transect locations are presented in Figures 2 and 3, and details of all of these transects (name, number of points, visit dates) are presented in Appendix A. UTM coordinates of all point count stations are presented in electronic format on the enclosed compact disc (Supplement A).

**Figure 2. San Francisco Bay Area
National Parks Inventory Sites (North)**



**Figure 3. San Francisco Bay Area
National Parks Inventory Sites (South)**



Point count census stations were established in all major terrestrial habitats of the park. At least forty-five habitat alliances (consisting of 65 habitat associations) are found in the park, but we were only able to establish point count stations in 22 of them, including all the major alliances. Examining data at the alliance rather than association level allowed for greater sample sizes. The alliances that are not included in this inventory are ones that are relatively uncommon in the park and within which we were unable to establish point count stations, and include: native dunegrass; interior perennial grass; saltgrass; tufted hairgrass; mexican elderberry; blue blossom; sensitive manzanita; eastwood manzanita; Mount Tamalpais manzanita; woolly-leaf manzanita; leather oak; wax myrtle; coffeeberry; California sagebrush; dune lupine; scotch broom; poison oak; sweet-briar; hazel; coast buckwheat; and giant chinquapin. Additionally, we lumped the four willow alliances into one alliance (unidentified willow) due to species identification challenges.

In 1999, the starting locations of census routes were chosen non-randomly in an effort to census the major habitat types not thoroughly censused during the previous monitoring projects in the parks (Holmes et al. 1999). In 2000, additional point count stations were added in habitats that had not yet been adequately covered. Habitats that needed further coverage were determined using a program we developed to extrapolate the rate at which new species are encountered as points are added within a given habitat (See *Assessing Sufficient Coverage of Each Habitat*, below). For habitats in which at least 20 points were established prior to 2000, we ran this program using data collected prior to 2000 to determine if a sufficient percentage of the avifauna present were detected. From this function we determined those habitats in which we needed additional point count stations in order to achieve the goal of documenting at least 80% (and preferably, 90%) of the species regularly breeding in the park area for a given habitat. Through this we determined that redwood forest and Douglas fir forest habitats needed additional points, which we established in 2000. In 2000 we also established additional census stations in habitats with less than 20 points prior to that year, in an effort to have a minimum of 20 census stations per habitat. These habitats included eucalyptus, chaparral, grassland, bishop pine, dune scrub, and Monterey cypress. Suggested start points for these transects were chosen using a random point generator script for Arcview (ESRI 2000). Actual transect locations in 2000 were then chosen from these random starting points by field biologists based on access feasibility. Efforts were made in 2000 to establish as many transects as possible off-trail. However we were not always able to meet that goal of 20 points per habitat, as in some cases there was not enough accessible habitat within the parks.

Many of the census stations were marked with colored flagging tape labeled with the four-letter transect code and station number (Appendix A). They were also geo-located using GPS to facilitate relocation at all stations where coordinates could be collected. For the 37 out of 697 points where UTM coordinates could not be collected, locations were estimated and approximate UTM coordinates were added to the databases.

VEGETATION ASSESSMENT

Vegetation data were collected at point count census stations to relate the differences in bird species composition and abundance to differences in vegetation. Vegetation was assessed at each station using the standard relevé method (Ralph et al. 1993). General habitat characteristics of the site were recorded (aspect, slope, presence/absence of water, # snags and logs) and cover, mean height and mean dbh of each vegetation stratum (tree, shrub and herb) estimated. Within each vegetation stratum the species composition was determined and each species' relative cover recorded, as a percent of total cover for that stratum.

Point count stations were classified into appropriate habitat alliances and associations (Sawyer and Keeler-Wolf 1995, Keeler-Wolf 1999) by a computer program that identified dominant plant species from vegetation relevé data (Appendix B). In some cases the occurrence of a particular species (i.e. coast redwood) classified the alliance regardless of dominance. Some points were classified as “unknown” if the dominant species did not define an alliance or if the program did not recognize the dominant species as fitting any of the classifications; we classified some of these points into an alliance upon further examination. In all, bird data from 621 of the 697 points surveyed as part of this project were analyzed by habitat type. Such classifications were not made for the Presidio (PRES) due to the difficulty in establishing points in contiguous habitats within the urban setting of the area (but see Appendix G). Classifications for each point are given in an accompanied electronic Arcview-compatible databases (Supplement A).

STATISTICAL ANALYSIS

Point count census data yield information on abundance, species richness and species diversity. These indices can be determined for each transect or for each habitat type. In all analyses (unless specified otherwise) we only included birds detected within the 50m radius to standardize the unit area evaluated (Nur et al. 1999). We restricted most statistical analyses to species of passerines

(songbirds) and near-passerines (including hummingbirds, woodpeckers, and doves). We eliminated birds that are poorly censused with the point count method, which includes swallows, crows, ravens, waterfowl, wading birds, shorebirds, quail, raptors and owls, regardless of breeding status within these parks. We also eliminated transients (i. e., Golden-crowned Sparrow).

Index of abundance

We define the index of abundance (relative abundance) as the mean number of individuals detected at a point count station, calculated by dividing the total number of individuals detected within 50m of each station within a habitat (or along a transect) by the number of stations and by the number of visits. Modifications were made for habitats which contained some points (Home Range and Angel Island transects) that were only censused once or twice in order to maintain consistency and comparability between points. We calculate this index for each habitat type in two ways: first, the overall abundance (all species combined); and second, for each species separately. For each habitat, we present the average total number of individuals detected per point and the average number of individuals of each species detected per point.

Species richness

Species richness is the total number of species detected within 50 meters. Richness can be presented as cumulative species richness (total number of species detected within a habitat or along a transect) or as mean species richness (average number of species detected per point within a habitat or transect). Presenting the mean species richness allows for comparisons between transects or habitats consisting of different numbers of point count stations. Although it is not appropriate to compare cumulative species richness between habitats or transects containing different numbers of point count stations, it can nevertheless be informative to know the cumulative number of species detected within a given habitat. For habitats that contained points only censused once or twice, Angel Island and Home Ranch, the richness might be artificially lower than points visited three times. This should be taken into account when comparing habitats.

Diversity

Species diversity measures the number of species detected within 50 m (*species richness*) weighted by the number of individuals of each species. A high diversity score indicates high

ecological (species) diversity, or a more equal representation of the species. Species diversity was measured using a modification of the Shannon-Wiener index (also called Shannon-Weaver index or just Shannon index; Krebs 1989). We used a transformation of the usual Shannon-Weiner index (symbolized H'), which reflects species richness and equal distribution of the species. This transformed index, which was introduced by MacArthur (1965) is N_1 , where $N_1 = 2^{H'}$. The advantage of N_1 over the original Shannon-Wiener metric (H') is that N_1 is measured in terms of species instead of bits of information, and thus the former is more easily interpretable. For habitats that contained points only censused once or twice, Angel Island and Home Ranch, the diversity might be slightly different than points visited three times. As with richness, diversity can be presented for the entire transect or habitat; and as the mean diversity per point, to allow for comparisons. We choose to present only the mean diversity in this report due to the inappropriateness of comparing total diversity between habitat types containing different numbers of points.

ASSESSING SUFFICIENT COVERAGE OF EACH HABITAT

Although it is not possible to directly determine the percentage of species breeding in the parks that were documented in our inventory, we needed to assess the likelihood that we had achieved our goal of documenting at least 80% (preferably 90%) of the bird species breeding within the parks. We wrote a cumulative species function program to extrapolate the rate at which new species are encountered as points are added within a given habitat. Only detections <50 m were used in analysis, and only habitats with more than 5 points were included. Habitats with fewer than 5 points were clearly not adequately assessed; and coverage was likely limited for habitats with more than 5 but fewer than 20 points. The program uses randomly selected subsets of the points in given habitats in a bootstrap approach run 100 times. Mean and 95% confidence intervals were generated. We used this program to determine if a sufficient percentage of the avifauna present were likely detected. We ran the program halfway through the inventory to determine if additional points were needed in any of the habitats (see *Selection of Study Sites* above) and at the end of the final year of inventory to ascertain the completeness of the inventory.

RESULTS AND DISCUSSION

POINT COUNT CENSUS

A total of 131 species were recorded at point count stations over the two-year inventory, 100 of which were detected within 50 m of the point count stations. Detections of individuals of all species (regardless of breeding status within the parks or appropriateness of this census technique for that particular species) within 50m are presented for each habitat type in Appendix C. Additional species detected only outside of 50 m and as flyovers are presented in Appendix D.

Summary statistics for each habitat are presented in Table 1, including mean diversity, mean species richness, cumulative species richness and indices of abundance. Species diversity measures the number of species detected within 50 m (species richness) weighted by the number of individuals of each species. Mean species richness is the average number of species detected at each point, whereas cumulative species richness is the overall number of species detected across all points in that habitat (see *Statistical Analysis* above). The index of abundance is defined as the mean number of individuals detected at a point count station. No single statistic alone provides a clear picture of the bird community; they must be examined in combination.

Mean abundances of species by habitat (mean number of individuals detected during a census at a point) are presented in Appendix E. All results pertain to detections within 50m and for passerine and near-passerines censused well by the point count method, except when specified.

Only one landbird species - the ubiquitous Song Sparrow - was detected in all habitats within the San Francisco Bay national parks during the inventory. Six other species were detected in all habitats except dune sagewort; these were Allen's Hummingbird, Bewick's Wren, California Towhee, Purple Finch, Spotted Towhee, and Wilson's Warbler.

TABLE 1. Species diversity, richness (overall and mean), and abundance indices for all habitats censused during the San Francisco Bay Area national parks inventory, all detections within 50m.

Habitat Alliance	Habitat Code	Number of points	Mean Diversity (N1)	Mean Species Richness	Cumulative Species Richness	Index of Abundance
Habitats with more than 5 points censused:						
Annual Grassland	GR	63	2.25	2.63	27	2.8
Bishop Pine	BP	26	8.86	10.19	28	7.05
California Bay	BA	44	7.26	8.36	49	5.28
Coast Live Oak	LO	22	6.80	7.73	45	8.42
Coast Redwood	RW	50	5.32	5.96	35	3.81
Coyote Brush	CB	114	4.45	5.33	45	4.51
Douglas Fir	DF	88	7.82	9.16	47	6.15
Dune Sagewort	DS	12	1.38	1.58	5	1.61
Eucalyptus	EU	28	7.78	9.21	36	6.01
Monterey Pine	MP	9	7.09	8.33	29	7.69
Red Alder	RA	44	8.77	10.55	43	7.47
Tanoak	TO	11	5.32	6.00	19	3.33
Willow	WI	97	7.42	9.21	46	7.19
Habitats with fewer than 5 points censused:						
Box Elder	BE	1	7.00	8.00	8	7.33
Buckeye	BU	1	8.91	10.00	10	6.33
Chamise	CH	1	6.24	7.00	7	3
European Dunegrass	AM	3	1.55	1.67	3	1
French Broom	FB	2	1.45	1.40	2	1
Pacific Reedgrass	RE	1	1.51	2.00	2	2.33
Rush	RU	1	4.61	6.00	6	6.67
Salmonberry	SB	1	7.97	10.00	10	9
Yellow Bush Lupine	LU	3	1.86	2.00	2	2.44

HABITAT AND BIRD RELATIONS

For the 13 habitat alliances in which we established more than 5 point count stations, we examine and describe the species composition, species of greatest abundance, and species unique to that habitat type.

Annual Grassland (63 points, mean diversity 2.25, mean richness 2.63, mean abundance 2.8)

Points within grassland habitat, largely dominated by introduced European annual grasses (Shuford and Timossi 1989), had one of the lowest indices of bird diversity, richness, and abundance of all major habitats. The bird species of greatest abundance in this habitat were

Nuttall's White-crowned Sparrow, Red-winged Blackbird, Savannah Sparrow, and Song Sparrow. Grasshopper Sparrows, House Sparrows, and Savannah Sparrows were more abundant in grassland habitat than any other habitat-type. Although abundance was low, this was the only habitat in which Rock Doves (as many points were near ranches) and Western Meadowlarks were detected, and one of only two habitats in which Lark Sparrows were detected.

Bishop Pine (26 points, mean diversity 8.86, mean richness 10.19, mean abundance 7.05)

In this alliance, in which Bishop pine dominates the overstory, indices of abundance, richness, and diversity were among the highest. Bird species of greatest abundance within this alliance were Allen's Hummingbird, Chestnut-backed Chickadee, Swainson's Thrush, Winter Wren, and Wrentit. More Chestnut-backed Chickadees, Pine Siskins, Pygmy Nuthatches, Swainson's Thrushes, and Wrentits were detected in the Bishop pine alliance than in other alliances. Some of the points within this habitat type may have been affected by the Mt. Vision fire.

California Bay (44 points, mean diversity 7.26, mean richness 8.36, mean abundance 5.28)

In forests dominated or co-dominated by California bay, bird species richness and diversity were above average, with an average index of abundance. Species of greatest abundance in this habitat were Chestnut-backed Chickadee, Song Sparrow, and Wilson's Warbler. Belted Kingfishers were detected in only a few alliances and were more abundant in the California bay alliance. This was the only habitat in which Nuttall's Woodpecker and Oak Titmouse were detected.

Coast Live Oak (22 points, mean diversity 6.8, mean richness 7.73, mean abundance 8.42)

The coast live oak alliance, interestingly, had the highest bird abundance of all, while diversity and richness were among the average. Fifteen species, the highest number of all habitat types, were more abundant in coast live oak than other habitats. These species included Anna's Hummingbird, Bushtit, Chipping Sparrow, Downy Woodpecker, House Finch, Oregon Junco, Spotted Towhee, Steller's Jay, and Western Scrub-Jay. Black-throated Gray Warbler, Lazuli Bunting, MacGillivray's Warbler, Pileated Woodpecker, Red-breasted Nuthatch, and Western Bluebird were detected in only a few habitats and were most abundant in the coast live oak

alliance. The most abundant species within this alliance were Bushtit, Chestnut-backed Chickadee, Oregon Junco, Pacific-slope Flycatcher, Spotted Towhee, and Western Scrub-Jay.

Coast Redwood (50 points, mean diversity 5.32, mean richness 5.96, mean abundance 3.81)

A point at which any redwood tree is found, regardless of size or density, is classified within the coast redwood alliance (Sawyer and Keeler-Wolf 1995, Keeler-Wolf 1999). Points in redwood had average diversity and richness indices, but a lower index of abundance, indicating that although species were present, fewer individuals of those species were detected. Bird species most abundant in coast redwood were Chestnut-backed Chickadee, Pacific-slope Flycatcher, Wilson's Warbler, and Winter Wren. Band-tailed Pigeons were more abundant in this habitat than any others. The only Hermit Warbler detected within 50 m was heard at a point in the coast redwood alliance.

Coyote Brush (114 points, mean diversity 4.45, mean richness 5.33, mean abundance 4.51)

Within the diverse and variable coyote brush alliance, mean diversity, richness and abundance were lower than within some other alliances. The most abundant species here were Nuttall's White-crowned Sparrow, Spotted Towhee, and Wrentit. There were no species more abundant in the coyote brush alliance than other alliances. California Thrashers, Lesser Goldfinches, Northern Mockingbirds, Rufous-crowned Sparrows, and Western Kingbirds were detected only in coyote brush habitat.

Douglas Fir (88 points, mean diversity 7.82, mean richness 9.16, mean abundance 6.15)

Points within this habitat, dominated by Douglas fir, were among the highest in diversity and richness. Species most abundant were Chestnut-backed Chickadee, Spotted Towhee, Swainson's Thrush, and Wilson's Warbler. Golden-crowned Kinglets were more abundant in the Douglas fir alliance than other alliances. Red-breasted Nuthatch and Pileated Woodpecker were both detected in only a few habitats, one of which was Douglas fir.

Dune Sagewort (12 points, mean diversity 1.38, mean richness 1.58, mean abundance 1.61)

Not unexpectedly, this alliance of sparse vegetation supported the least diverse, rich and abundant landbird community. The two most abundant species, Nuttall's White-crowned Sparrow and Horned Lark, were more abundant in dune sagewort than in other alliances.

Eucalyptus (28 points, mean diversity 7.78, mean richness 9.21, mean abundance 6.01)

This habitat, dominated by the invasive exotic eucalyptus, had among the highest index of bird species richness, a slightly high diversity, and a relatively average index of abundance. The bird species of greatest abundance in this alliance were Allen's Hummingbird, Chestnut-backed Chickadee, European Starling, Pacific-slope Flycatcher, and Purple Finch. Allen's Hummingbird, European Starling, Mourning Dove, Olive-sided Flycatcher, Purple Finch, Red-winged Blackbirds, and Steller's Jays were more abundant in eucalyptus than in other habitats. Many of the individuals detected within this often patchy habitat may be using it for foraging or perching (both Olive-sided Flycatchers and Purple Finches often sing from the highest perches available in their territories) and not necessarily for nesting. The abundance of European Starlings within eucalyptus habitat was among the highest found for any species in any habitat.

Monterey Pine (9 points, mean diversity 7.09, mean richness 8.33, mean abundance 7.69)

Points in the Monterey pine alliance had average diversity and richness indices and a relatively high index of abundance. Bird species of greatest abundance were the American Goldfinch, Bewick's Wren, Chestnut-backed Chickadee, and Song Sparrow. Seven species - American Goldfinch, American Robin, Bewick's Wren, Brewer's Blackbird, Hairy Woodpecker, Hutton's Vireo, and Red-shafted Flicker - were more abundant in this habitat than any other.

Red Alder (44 points, mean diversity 8.77, mean richness 10.55, mean abundance 7.47)

This alliance, dominated by stands of deciduous broad-leaved trees within riparian forests and woodlands, had the highest species richness and above average species diversity and index of abundance. Eight species were more abundant in red alder than in other alliances: Acorn Woodpecker, Brown-headed Cowbird, Black-headed Grosbeak, Black Phoebe, Orange-crowned Warbler, Song Sparrow, Warbling Vireo, Western Wood-Pewee, and Wilson's Warbler. The most abundant species within this habitat type were Song Sparrow, Swainson's Thrush, and

Wilson's Warbler. More information on these three species and others of conservation focus in California's riparian habitat is available (RHJV 2000).

Tanoak (11 points, mean diversity 5.32, mean richness 6.00, mean abundance 3.33)

Forests dominated by tanoak, with less than 40% of canopy composed of other species, are rare throughout the parks but occurs in northern and southern areas adjacent to redwood and Douglas fir forests. Within this alliance indices of diversity, richness, and abundance were low compared to other habitats. The species of most abundance within the tanoak alliance were Chestnut-backed Chickadee, Pacific-slope Flycatcher, and Winter Wren. Brown Creepers, Hermit Thrushes, Pacific-slope Flycatchers, and Winter Wrens were more abundant here than in other habitats.

Willow (97 points, mean diversity 7.42, mean richness 9.21, mean abundance 7.19)

This alliance, usually riparian areas comprised of a variety of willow species (often not identified in releves), had among the highest indices of richness, diversity, and abundance. Bird species most abundant within this alliance were Song Sparrows, Swainson's Thrushes, and Wilson's Warblers. This habitat had a higher abundance of Ash-throated Flycatchers and Common Yellowthroats than all other habitats. Marsh Wrens, only detected within the red alder and willow alliances, were more abundant in the willow alliance. Yellow Warblers, only detected in the California bay alliance and the willow alliance, were more abundant in the willow alliance. Bullock's Orioles were only detected in the willow alliance. More information on many of these species and others of conservation focus in California's riparian habitat is available (RHJV 2000).

Other Habitat Alliances

Nine alliance classifications were assigned that contained fewer than 5 points each. A sample size of at least twenty points was not achieved for these habitat types either because there was not enough accessible habitat within the parks, or because the very specific habitat alliances were not determined until after the inventory data had been collected. These habitats include box elder, buckeye, chamise, European dunegrass, French broom, pacific reedgrass, rush, salmonberry, and yellow bush lupine.

ASSESSING SUFFICIENT COVERAGE OF EACH HABITAT

The results from the cumulative species function program indicate that our coverage of primary habitats within PORE and GOGA meets the 90% detection criterion (Table 2). For 5 of the 13 habitats included in this portion of analysis, 80% of the species detected within each habitat type were detected after just a quarter to a third of the points had been surveyed. For 7 of the 13 habitats, the 80% mark was reached after approximately half the points within that habitat had been surveyed. In just one habitat (Monterey pine) was this marker reached after more than half the points had been surveyed, supporting the importance of higher sample sizes. 100% of all the species detected in each habitat were detected for all habitats before the final point was censused. The slope (rate at which new species were detected as points were added) was less than 1 for all 13 habitats at the 80% mark and at the 100% mark, which means that less than one species was being added per new point established. Although it is not possible to directly determine the percentage of species breeding in the park that were documented in our inventory, from our data and the opinion of field ornithologists familiar with the park's avifauna we conclude that at least 90% of the birds breeding within the park were likely censused.

Table 2 Assessment of sufficient habitat coverage in the San Francisco Bay Area National Park Service Inventory. (mean \pm 95% confidence interval)

Habitat	# points	# pts at which 80% spp detected	# pts at which 100% spp detected	Avg. slope 80%	Avg. slope 100%
California Bay	44	21.47 \pm 0.83	41.23 \pm 0.53	0.59 \pm 0.05	0.50 \pm 0.06
Bishop Pine	26	9.67 \pm 0.50	22.89 \pm 0.54	0.67 \pm 0.06	0.53 \pm 0.07
Coyote Brush	114	57.68 \pm 2.74	105.65 \pm 1.46	0.44 \pm 0.06	0.28 \pm 0.05
Douglas Fir	88	27.29 \pm 1.29	79.05 \pm 1.64	0.47 \pm 0.06	0.31 \pm 0.56
Dune Sagewort	12	4.82 \pm 0.39	7.86 \pm 0.49	0.61 \pm 0.06	0.48 \pm 0.06
Eucalyptus	28	8.65 \pm 0.49	23.54 \pm 0.75	0.66 \pm 0.05	0.42 \pm 0.06
Annual Grassland	60	29.62 \pm 1.38	53.49 \pm 1.19	0.45 \pm 0.05	0.33 \pm 0.05
Coast Live Oak	22	11.21 \pm 0.34	20.96 \pm 0.26	0.69 \pm 0.05	0.65 \pm 0.05
Monterey Pine	9	6.06 \pm 0.21	8.66 \pm 0.11	0.66 \pm 0.05	0.70 \pm 0.05
Red Alder	44	12.67 \pm 0.56	38.57 \pm 0.91	0.62 \pm 0.05	0.36 \pm 0.06
Coast Redwood	50	21.41 \pm 1.12	46.04 \pm 0.80	0.54 \pm 0.06	0.38 \pm 0.05
Tanoak	11	6.17 \pm 0.28	10.08 \pm 0.24	0.67 \pm 0.05	0.57 \pm 0.05
Willow	97	24.06 \pm 1.12	82.62 \pm 2.07	0.53 \pm 0.06	0.19 \pm 0.05
All habitats combined ¹	694	83.32 \pm 4.64	608.28 \pm 14.52	0.31 \pm 0.06	0.10 \pm 0.04

¹includes habitats with less than 5 points and points not classified to any alliance ("unknown")

GIS DATABASE

This report includes GIS databases on a compact disc with point count data and vegetation data for all of the areas surveyed (Supplement A). With this database it is possible to create maps for any species of interest, detailing their presence or absence at all points throughout the park, at different transects and within different habitats, and to determine which areas had the highest abundance of that species. For the 37 points where UTMs could not be collected, locations of points are *estimated* in this database and on the maps. With this database, park personnel can examine for each point the abundance of each species (within 50m); total abundance of each species detected (combining detections within 50m, greater than 50m, and flyovers); and overall indices of abundance, diversity, and species richness. Appendix F details the fields and uses of the GIS databases.

MONITORING RECOMMENDATIONS

Because a long-term bird monitoring plan will be implemented within San Francisco Bay Area national parks, most of the 697 points surveyed during this two-year inventory were georeferenced in order to enable monitoring in subsequent years. We recommend that when these points or a subset of these points are repeated, they be done in accordance with the protocols we outlined above. Staff should be familiar with the songs and calls of most local birds and be adequately trained and prepared before the onset of the point count season. Monitoring protocols should be in accordance those outlined in Ralph et al. 1993, Ralph et al. 1995, and Nur et al. 1999. We recommend these three resources to all biologists implementing or analyzing monitoring programs.

VARIABLE CIRCULAR PLOT POINT COUNTS

If the biologists conducting the censuses are sufficiently experienced, have an intensive training period, and calibrate their distance estimations at regular intervals throughout the season, variable circular plot (VCP) point count methodology should be used instead of fixed radius point counts. With VCP point counts, in which distances to each individual bird detected are estimated and recorded, it is possible to determine detectability of different species and in different habitats. This would allow for comparison of data collected at PRNS and GGNRA to data being collected at other national parks (Fancy and Sauer 2000). The duration of the point count must still be 5 minutes in order to compare to most point count data being collected, including previous data collected at San Francisco Bay Area

national parks. If it is also desired to make future data comparable to Breeding Bird Survey (BBS) data (3 minute VCPs), it is possible to mark the data sheet after 3 minutes and then continue collecting the last 2 minutes of data.

REPEATED VISITS

If staff availability limits the number of censuses that can be conducted in a given year, we still recommend each transect be censused three times during the appropriate period of the breeding season (late April through early-July). We suggest dropping the number of points censused rather than the number of visits. Conducting single visits to a site per season biases the data against species that tend to be more abundant or vocal during one part of the breeding season, and decreases the likelihood of detecting less common species.

MONITORING OPTIONS

We present three potential long-term monitoring options using the inventory point count stations, dependant on personnel availability, funding, and staff or intern payment rates.

Option 1- Highest Level of Staffing

Personnel requirement: minimum of three full-time field biologists during the breeding season for just the point count and nest searching elements of long-term monitoring.

- Continue long-term monitoring by repeating point counts yearly at approximately 243 of the 697 points established during the inventory, across 13 major habitat types inventoried. This number of points, essentially one third of the total number censused in this inventory, is based upon the number needed within each habitat to monitor approximately 80% of the birds detected in that habitat, as estimated by the cumulative species function program (Table 2). Transects chosen may be selected at random
- Prioritize which of the transects within each habitat will be monitored long-term, based on (1) location (focusing on areas of interest to the park), (2) ecological issues (i.e. fire and Sudden Oak Death Syndrome (SODS)), and (3) population parameters given in this report (e.g., choosing transects with high mean species richness may allow this long-term monitoring to include a greater number of species; see Appendix G for details of each transect).

- Measure vegetation characteristics at each point count census station every three years, using standard protocol as outlined on PRBO's website (www.prbo.org).
- Continue standardized mist-netting at established sites, the Palomarin Field Station and Muddy Hollow Trail, to estimate productivity and population health of selected species.
- Conduct nest searching and monitoring at select sites. These may include sites or habitats of particular interest to the park, sites where species of conservation interest have been detected, or sites where species have been detected of unknown breeding status.

Option 2 - Moderate level of staffing

Personnel requirements: three part-time field biologists, or two full-time field biologists, for just the point count element of long-term monitoring.

- A similar option for less staff availability would be to divide the selected transects that were chosen to be monitored long-term (see *Option 1*) into two or three subsets, depending on available resources. If divided into two subsets, each subset (consisting of approximately 120 points) would be censused twice a year every second year. If divided into three subsets, each subset (consisting of approximately 80 points) would be censused twice a year every third year.
- For habitats with enough transects, we recommend that at least one transect from each habitat is censused annually to evaluate potential year-effects.
- Measure vegetation characteristics at each point count census station every four to six years (depending on whether station is censused every two or three years, respectively) using standard protocol as outlined on PRBO's website (www.prbo.org).
- Continue standardized mist-netting at established sites, the Palomarin Field Station and Muddy Hollow Trail, to estimate productivity and population health of selected species.

Option 3 - Lowest level of staffing

Personnel requirements: one full-time field biologist.

- Point count censuses are conducted in select habitats and select transects only. We recommend that the park prioritize which transects to monitor based on habitats of particular management interest to the park (e.g., burn, SODS), or transects with high population parameters as detailed in this report. Thus long-term monitoring would take place in areas of specific conservation or management

priority, in the habitats that most typify the park, and in habitats which contain the most species or the most individuals.

- Each of these transects can be monitored every second or third year depending on available resources.
- Measure vegetation characteristics at each point count census station every four to six years.

PERSONNEL

In 1999 this project was coordinated by PRBO biologists Thomas Gardali and Aaron Holmes. Point counts and vegetation assessments were conducted primarily by PRBO biologists Thomas Gardali, Aaron Holmes, Diana Humple, Sandra Scoggin, and Jennifer White. Transects near the Palomarin Field Station were censused by PRBO staff and interns Johanne Berthiaume, Mario Castellanos, Jackie Cerretani, David Dixon, and Greg Elliot.

In 2000, project coordinators were Thomas Gardali and Maureen Flannery. Point counts and vegetation assessments were conducted primarily by PRBO biologists Ryan DiGaudio, Maureen Flannery, Thomas Gardali, and Mike Lynes. Transects near the Palomarin Field Station were censused by PRBO interns David Cowell, Cody Martz, and Nik Tatarnic. David Wimpfheimer conducted point counts and vegetation assessments at Angel Island and Home Ranch sites. Dusty Miller assisted with vegetation assessments. In both years, much of the Presidio was censused by volunteer Josiah Clark.

The transects censused in 1998 under separate contracts were done by Tom Gardali, Aaron Holmes, Diana Humple, Mike Lynes, and Sandra Scoggin.

Data preparation and analysis were done by Diana Humple and Maureen Flannery. Computer programs used to manage and summarize data were created by PRBO staff Grant Ballard and Mike Lynes. Diana Stralberg and Anne Black worked on GIS elements of this project and report. This project was carried out under the guidance of PRBO's Terrestrial Program Director Geoffrey Geupel and Quantitative Ecologist Nadav Nur.

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Appendix A.

Names and dates of point count visits, San Francisco Bay Area national parks inventory, 1998-2000.

Station Abbrev.	Station Name	#of points	Visit 1	Visit 2	Visit 3
1998 point count transects					
ABKE	Abbot's / Kehoe	16	4/29/98	6/3/98	6/29/98
BEVA	Bear Valley	16	4/27/98	6/2/98	6/25/98
COCA	Coast Camp	8	5/15/98	6/3/98	6/30/98
CRTR	Coyote Ridge Trail	15	5/13/98	6/2/98	6/24/98
CTLA	Coast Trail Lagunitas	13	5/7/98	5/26/98	6/29/98
GERB	Gerbode Valley	18	5/5/98	5/31/98	6/18/98
LOOL	Lower Olema Creek	15	4/28/98	6/5/98	6/26/98
MOGU	Morse's Gulch	15	5/13/98	5/30/98	6/22/98
MRAN	M Ranch	8	5/11/98	6/11/98	7/1/98
MUHO	Muddy Hollow	17	4/27/98	5/30/98	6/25/98
PRHN	Point Reyes Headland North	15	5/13/98	6/2/98	6/28/98
PRHS	Point Reyes Headland South	15	5/14/98	6/1/98	6/28/98
RODE	Rodeo / Bobcat Trail	15	5/6/98	5/20/98	6/18/98
STGU	Stinson Gulch	15	5/5/98	5/30/98	6/14/98
STRA	Stewart Ranch	15	5/6/98	6/1/98	6/19/98
TEVA	Tennessee Valley	14	4/28/98	5/30/98	6/17/98
TOMN	Tomales Point North	15	5/15/98	6/5/98	7/3/98
TOMS	Tomales Point South	15	5/11/98	6/3/98	6/24/98
UPOL	Upper Olema Creek	13	4/28/98	6/1/98	6/24/98
1999 point count transects					
ARHO	Arroyo Hondo	6	4/28/99	6/7/99	6/30/99
BJTR	Ben Johnson Trail	15	5/12/99	5/27/99	6/30/99
BORT	Bolinas Ridge Trail	25	5/28/99	6/11/99	7/1/99
BOTR	Bootjack Trail	15	5/12/99	6/8/99	6/28/99
DUSC	Dune Scrub	7	5/26/99	6/16/99	6/29/99
INRI	Inverness Ridge	4	5/21/99	6/8/99	7/1/99
JACR	Jack's Creek	6	5/25/99	6/14/99	6/29/99
JEPS	Jepson Trail	6	5/21/99	6/8/99	7/1/99
LACR	Lagunitas Creek	18	5/10/99	5/27/99	6/16/99
MCTR	McCurdy Trail	6	5/27/99	6/14/99	6/28/99
MIRI	Milagra Ridge	9	5/21/99	6/5/99	6/29/99
MTWI	Mt. Wittenberg	10	6/2/99	6/17/99	6/28/99
MWOT	Muir Woods Off Trail	15	5/12/99	6/10/99	6/29/99
OPTR	Old Pine Trail	10	5/21/99	6/8/99	6/21/99
PAG5	Palomarin Grid 5	4	5/20/99	6/12/99	7/3/99
PHES	Phleger Estates	9	5/13/99	6/7/99	7/2/99
PIGU	Pine Gulch	5	5/11/99	6/19/99	6/30/99
PRES	Presidio	24	5/20/99, 5/22/99	6/8/99, 6/9/99	6/27/99, 6/30/99
RECR	Redwood Creek	24	5/7/99	5/26/99	6/12/99
RITR	Ridge Trail	8	5/22/99	6/2/99	6/17/99
SPBP	Samuel P. Taylor Bike Path	10	5/26/99	6/9/99	7/1/99
SWRI	Sweeney Ridge	12	5/21/99	6/5/99	6/29/99

Station Abbrev.	Station Name	#of points	Visit 1	Visit 2	Visit 3
2000 point count transects					
ANIS	Angel Island	12	6/19/00		
ATT	AT+T	7	5/16/00	6/6/00	6/25/00
ATTG	AT+T Grassland	7	5/16/00, 5/17/00	6/9/00	7/6/00
ATTS	AT+T Scrub	4	5/16/00	6/9/00	7/6/00
BVMT	Bear Valley Meadow Trail	11	5/8/00	6/6/00	7/6/00
BIP1	Bishop Pine 1	8	5/20/00	6/11/00	6/28/00
BIP2	Bishop Pine 2	8	5/22/00	6/12/00	6/30/00
BIP3	Bishop Pine 3	4	5/23/00	6/13/00	7/6/00
CGEU	Coast Guard Eucalyptus	8	5/17/00	6/9/00	7/6/00
CTPA	Coast Trail Palomarin	14	5/14/00	6/1/00	6/26/00
DEGU	Deadman's Gulch	6	6/2/00	6/15/00	7/11/00
EUMV	Eucalyptus Mill Valley	10	5/11/00	6/5/00	6/28/00
HORA	Home Ranch	10	6/17/00	7/6/00	
MCDU	McClure's Ranch Dunes	12	5/24/00	6/12/00	6/29/00
MEEU	Mesa Road Eucalyptus	2	5/14/00	6/11/00	6/29/00
OLGR	Olema Grassland	10	5/12/00	6/7/00	7/1/00
OPDS	Outer Point Dune Scrub	12	5/17/00	6/10/00	6/26/00
PALO	Palomarin Grids	13	5/11/00	5/25/00	6/13/00
RATR	Randall Trail	8	5/11/00	6/5/00	6/28/00
UPRT	Upper Ridge Trail	10	5/9/00	6/4/00	6/29/00, 7/2/00

APPENDIX B.

Vegetation classification descriptions taken from Keeler-Wolf (1999) used during the San Francisco Bay Area national parks inventory.

Habitat	Code	Alliance Classification
Habitats with more than 5 points censused:		
bishop pine	BP	Bishop Pine (<i>Pinus muricata</i>) Alliance (03030)
California bay	BA	California Bay (<i>Umbellularia californica</i>) Alliance (01010)
coast live oak	LO	Coast Live Oak (<i>Quercus Agrifolia</i>) Alliance (12020)
coast redwood	RW	Coast Redwood (<i>Sequoia sempervirens</i>) Alliance (02050)
coyote brush	CB	Coyote Brush (<i>Baccharis pilularis</i>) Alliance (24050)
Douglas fir	DF	Douglas-fir (<i>Pseudotsuga menziesii</i>) Alliance (02010), either the 02011 Association or 02020 Association
dune sagewort	DS	Dune Sagewort (<i>Artemisia pycnocephala</i>) Alliance (62052, 62051)
dune scrub	DS	Dune Lupine-Goldenbush Alliance
eucalyptus	EU	<i>Eucalyptus</i> spp. Stands (01030)
grassland	GR	California Annual Grassland Weedy Alliance (67010), CA Annual Grasslands with Native Component (67020), Introduced Perennial Grassland (47030)
Monterey pine	MP	Monterey Pine (<i>Pinus radiata</i>) dominated
red alder	RA	Red Alder (<i>Alnus rubra</i>) Alliance (07070)
tanoak	TO	Tanoak (<i>Lithocarpus densiflorus</i>) Alliance (01070)
willow	WI	Arroyo Willow (<i>Salix lasiolepis</i>) (07060, 32080), Yellow Willow (<i>Salix lucida</i>) (07060), unid. willow (07000) Red Willow (<i>Salix laevigata</i>) Alliances (07060)
Habitats with fewer than 5 points censused:		
box elder	BE	Box Elder (<i>Acer negundo</i>) dominated
buckeye	BU	California Buckeye (<i>Aesculus californica</i>) Alliance (14020)
chamise	CH	Chamise (<i>Adenostoma fasciculatum</i>) Alliance (21100, 21140)
European dunegrass	AM	European Dunegrass (<i>Amophila arenaria</i>) Alliance (47010)
French broom	FB	Broom (<i>Cytisus</i> spp.) Alliance (24040)
pacific reedgrass	RE	Pacific Reedgrass (<i>Calamagrostis nutkaensis</i>) Alliance (46020)
rush	RU	Rush (<i>Juncus</i> spp.) Alliance (52032, grouped to 52030)
salmonberry	SB	Salmonberry (<i>Rubus spectabilis</i>) Alliance (no p.i. code)
yellow bush lupine	LU	Yellow Bush Lupine (<i>Lupinus arboreus</i>) Alliance (19010)

APPENDIX C.

Total number of detections of all species by habitat during the San Francisco Bay Area national parks inventory point counts. Detections are all within 50m. Number of points within the habitat are given beneath the 2-letter habitat abbreviation. Common names are in accordance with AOU Checklist (1983) and supplements; some subspecific names are taken from the AOU Checklist (1957).

Species	Code # points	Habitat Alliance (>5 pts) ¹												Habitat Alliance (<5pts) ¹									
		BA 44	BP 26	CB 114	DF 90	DS 12	EU 27	GR 63	LO 22	MP 9	RA 44	RW 50	TO 11	WI 97	AM 3	BE 1	BU 1	CH 1	FB 2	LU 3	RE 1	RU 1	SB 1
Acorn Woodpecker	ACWO	1	0	0	7	0	0	0	1	0	5	2	0	0	0	0	0	0	0	0	0	0	0
Allen's Hummingbird	ALHU	26	35	60	70	0	38	3	8	1	47	17	3	104	0	2	1	0	0	0	0	0	1
American Coot	AMCO	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
American Crow	AMCR	3	1	0	0	0	1	1	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0
American Goldfinch	AMGO	2	2	39	5	0	12	9	0	21	24	0	0	54	0	0	0	0	0	0	0	2	1
American Kestrel	AMKE	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Robin	AMRO	19	1	0	29	0	14	1	4	7	27	6	2	35	0	0	0	0	0	0	0	0	0
Anna's Hummingbird	ANHU	2	4	27	13	0	7	0	8	4	8	1	2	23	0	0	0	0	0	0	0	0	0
Ash-throated Flycatcher	ATFL	1	0	1	0	0	2	0	0	0	3	0	0	12	0	0	0	0	0	0	0	0	0
Audubon's Warbler	AUWA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Barn Swallow	BARS	0	0	5	0	0	0	14	1	1	10	0	0	10	0	0	0	0	0	0	0	0	0
Belted Kingfisher	BEKI	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Bewick's Wren	BEWR	6	24	62	61	0	23	11	8	12	24	8	0	41	0	0	0	1	0	0	0	1	3
Brown-headed Cowbird	BHCO	1	0	19	1	1	4	10	6	1	22	0	0	58	0	0	0	0	0	0	0	0	0
Black-headed Grosbeak	BHGR	15	0	1	8	0	5	0	2	0	34	0	0	41	0	0	1	0	0	0	0	0	0
Black Phoebe	BLPH	1	0	1	0	0	0	0	1	0	8	2	0	4	0	0	0	0	0	0	0	0	0
Brewer's Blackbird	BRBL	1	0	8	1	0	3	13	1	7	15	0	0	48	3	0	0	0	1	0	0	0	0
Brown Creeper	BRCR	17	16	0	18	0	6	0	5	2	0	25	13	2	0	0	0	0	0	0	0	0	0
Band-tailed Pigeon	BTPI	5	2	5	9	0	0	0	0	0	9	13	2	0	0	0	0	0	0	0	0	0	0
Black-throated Gray Warbler	BTYW	4	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Bullock's Oriole	BUOR	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Bushtit	BUSH	15	0	28	31	0	3	0	34	0	21	12	0	45	0	0	0	0	0	0	0	0	0
California Towhee	CALT	15	3	20	28	0	9	4	5	3	15	1	0	32	0	0	0	0	0	0	0	0	0
California Quail	CAQU	15	1	41	31	0	9	0	32	5	59	1	0	25	0	0	0	0	0	0	0	0	0
California Thrasher	CATH	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Code # points	Habitat Alliance (>5 pts) ¹														Habitat Alliance (<5pts) ¹									
		BA	BP	CB	DF	DS	EU	GR	LO	MP	RA	RW	TO	WI	AM	BE	BU	CH	FB	LU	RE	RU	SB		
		44	26	114	90	12	27	63	22	9	44	50	11	97	3	1	1	1	2	3	1	1	1		
Chestnut-backed Chickadee	CBCH	80	62	21	172	0	41	0	21	12	51	81	15	91	0	2	2	0	0	0	0	0	5		
Cedar Waxwing	CEDW	0	0	0	0	0	123	0	0	0	4	0	0	32	0	1	0	0	0	0	0	0	0		
Chipping Sparrow	CHSP	1	0	2	1	0	0	3	5	0	1	0	0	1	0	0	0	0	0	0	0	0	0		
Cliff Swallow	CLSW	0	0	2	0	0	0	9	0	5	9	0	0	21	0	0	0	0	0	0	0	0	0		
Common Raven	CORA	2	2	5	1	0	1	0	1	0	1	8	1	0	0	0	0	0	0	0	0	0	0		
Common Yellowthroat	COYE	0	0	7	0	0	0	3	0	1	26	0	0	87	0	0	0	0	0	0	0	0	1		
Downy Woodpecker	DOWO	2	0	0	2	0	1	0	5	1	14	0	0	10	0	0	0	1	0	0	0	0	0		
European Starling	EUST	7	1	0	2	0	60	5	2	2	9	4	0	20	0	0	0	0	0	0	0	3	0		
Golden-crowned Kinglet	GCKI	15	0	3	75	0	0	0	1	0	0	18	6	0	0	0	0	0	0	0	0	0	0		
Golden-crowned Sparrow	GCSP	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0		
Great Horned Owl	GHOW	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		
Green Heron	GRHE	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
Grasshopper Sparrow	GRSP	0	0	2	0	0	0	9	1	0	0	0	0	0	0	0	0	0	5	0	0	0	0		
Hammond's Flycatcher	HAFL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
Hairy Woodpecker	HAWO	7	6	1	12	0	10	0	0	4	8	2	0	12	0	1	0	0	0	0	0	0	0		
Hermit Thrush	HETH	7	0	0	8	0	0	0	2	0	0	0	2	0	0	0	0	1	0	0	0	0	0		
Hermit Warbler	HEWA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
House Finch	HOFI	3	0	10	0	0	14	0	8	1	4	0	0	9	0	0	0	0	0	0	0	1	0		
Horned Lark	HOLA	0	0	0	0	12	0	10	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0		
House Sparrow	HOSP	0	0	0	0	0	0	5	0	0	1	0	0	5	0	0	0	0	0	0	0	0	0		
Hutton's Vireo	HUVI	5	10	2	15	0	1	0	8	3	5	7	0	4	0	0	0	0	0	0	0	0	0		
Killdeer	KILL	0	0	1	0	13	0	1	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0		
Lark Sparrow	LASP	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Lazuli Bunting	LAZB	0	0	3	0	0	0	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0		
Lesser Goldfinch	LEGO	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Marsh Wren	MAWR	0	0	0	0	0	0	0	0	0	1	0	0	22	0	0	0	0	0	0	0	0	0		
MacGillivray's Warbler	MGWA	1	0	1	0	0	1	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0		
Mourning Dove	MODO	4	5	3	4	0	16	0	0	0	12	1	0	12	0	0	0	0	0	0	0	0	0		
Northern Harrier	NOHA	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
Northern Mockingbird	NOMO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Northern Rough-winged Swallow	NRWS	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0		
Nuttall's Woodpecker	NUWO	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Nuttall's White-crowned Sparrow	NWCS	0	0	247	0	38	0	91	1	3	1	0	0	14	0	0	0	0	0	10	1	5	0		

Species	Code # points	Habitat Alliance (>5 pts) ¹														Habitat Alliance (<5pts) ¹									
		BA	BP	CB	DF	DS	EU	GR	LO	MP	RA	RW	TO	WI	AM	BE	BU	CH	FB	LU	RE	RU	SB		
		44	26	114	90	12	27	63	22	9	44	50	11	97	3	1	1	1	2	3	1	1	1		
Oak Titmouse	OATI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Orange-crowned Warbler	OCWA	9	3	26	36	0	3	0	5	1	38	5	1	37	0	1	0	0	0	0	0	0	1		
Oregon Junco	ORJU	38	14	5	73	0	26	4	17	5	0	23	6	0	0	0	0	0	0	0	0	0			
Olive-sided Flycatcher	OSFL	3	0	0	2	0	11	0	0	0	9	0	0	2	0	0	0	0	0	0	0	0			
Osprey	OSPR	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Pine Siskin	PISI	1	24	1	9	0	0	0	1	3	0	2	0	0	0	0	0	0	0	0	0	0			
Pileated Woodpecker	PIWO	1	0	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0			
Pacific-slope Flycatcher	PSFL	80	29	1	104	0	34	0	25	6	27	105	26	20	0	3	2	0	0	0	0	0			
Purple Finch	PUFI	10	22	22	40	0	34	5	2	3	6	8	1	10	0	0	0	0	0	0	0	0			
Pygmy Nuthatch	PYNU	4	27	16	3	0	0	0	3	0	0	6	2	0	0	0	0	0	0	0	0	0			
Red-breasted Nuthatch	RBNU	0	1	0	10	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0			
Ruby-crowned Kinglet	RCKI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0			
Rufous-crowned Sparrow	RCSP	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Rock Dove	RODO	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Red-shafted Flicker	RSFL	0	0	2	6	0	4	0	0	2	9	1	0	6	0	0	0	0	0	0	0	0			
Red-shouldered Hawk	RSHA	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0			
Red-tailed Hawk	RTHA	3	0	3	3	0	9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
Red-winged Blackbird	RWBL	0	0	19	1	0	0	53	0	0	24	0	0	232	0	0	0	0	0	0	0	0			
Savannah Sparrow	SAVS	0	0	91	0	5	0	199	2	0	0	0	0	1	4	0	0	0	0	0	6	0			
Song Sparrow	SOSP	51	6	355	103	2	14	71	18	16	197	3	0	426	0	4	3	0	0	12	0	8	7		
Spotted Towhee	SPTO	11	39	158	112	0	14	9	23	1	10	16	1	25	0	0	1	1	0	0	0	0	0		
Steller's Jay	STJA	14	5	1	37	0	23	0	10	0	16	18	2	6	0	0	0	1	0	0	0	0	0		
Swainson's Thrush	SWTH	34	54	13	134	0	10	0	12	8	77	29	0	147	0	4	2	0	0	0	0	0	2		
Townsend's Warbler	TOWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Tree Swallow	TRES	7	1	0	0	0	5	1	0	0	15	0	0	13	0	0	0	0	0	0	0	0			
Turkey Vulture	TUVU	1	2	2	2	0	0	0	0	0	4	2	0	14	0	0	0	0	0	0	0	0			
Vaux's Swift	VASW	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Violet-green Swallow	VGSW	2	2	1	0	0	0	3	0	3	6	0	0	14	0	0	0	0	0	0	0	0			
Virginia Rail	VIRA	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0			
Warbling Vireo	WAVI	27	1	0	20	0	4	0	10	0	34	21	7	53	0	0	2	0	0	0	0	0			
White-crowned Sparrow	WCSP	0	0	20	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Western Bluebird	WEBL	0	0	2	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0			
Western Meadowlark	WEME	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			

Species	Code # points	Habitat Alliance (>5 pts) ¹														Habitat Alliance (<5pts) ¹									
		BA	BP	CB	DF	DS	EU	GR	LO	MP	RA	RW	TO	WI	AM	BE	BU	CH	FB	LU	RE	RU	SB		
		44	26	114	90	12	27	63	22	9	44	50	11	97	3	1	1	1	2	3	1	1	1		
Western Scrub-jay	WESJ	5	0	42	25	0	9	0	18	2	15	7	0	43	0	0	0	0	0	0	0	0	3		
Western Tanager	WETA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Western Wood-Pewee	WEWP	7	0	0	3	0	4	1	4	0	16	0	0	5	0	0	0	0	0	0	0	0			
Whimbrel	WHIM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Willow Flycatcher	WIFL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0			
Wilson's Warbler	WIWA	74	70	32	157	0	28	1	20	2	97	44	4	199	0	5	4	1	0	0	0	3			
Winter Wren	WIWR	53	32	0	71	0	15	0	6	0	8	52	14	7	0	0	1	0	0	0	0	0			
Wrentit	WREN	7	52	117	86	0	2	0	7	2	7	20	0	77	0	0	0	3	0	0	0	0			
Yellow Warbler	YWAR	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0			

¹Habitat alliance codes: AM=European dunegrass; BA=California Bay; BE=boxelder; BP=bishop pine; BU=buckeye; CB=coyote brush; CH=chamise; DF=Douglas fir; DS=dune sagewort; EU=eucalyptus; FB=French broom; GR=annual grassland; LO=coast live oak; LU=yellow bush lupine; MP=Monterey pine; RA=red alder; RE=Pacific reedgrass; RU=rush; RW=coast redwood; SB=salmonberry; TO=tanoak; WI= willow.

APPENDIX D.

Species detected outside of 50 m and as flyovers during the San Francisco Bay Area national parks inventory point counts.

Species detected as > 50 m.

American Coot (AMCO)

American Crow (AMCR)

Audubon's Warbler (AUWA)

Black Rail (BLRA)

Bufflehead (BUFF)

Canada Goose (CAGO)

Common Raven (CORA)

Gadwall (GADW)

Northern Parula (NOPA)

Osprey (OSPR)

Pied-billed Grebe (PBGR)

Peregrine Falcon (PEFA)

Red-necked Phalarope (RNPH)

Red-shouldered Hawk (RSHA)

Red-tailed Hawk (RTHA)

Violet-green Swallow (VGSW)

Western Tanager (WETA)

Willow Flycatcher (WIFL)

Wood Duck (WODU)

Species detected as flyovers

American White Pelican (AWPE)

California Gull (CAGU)

Caspian Tern (CATE)

Common Loon (COLO)

Double-crested Cormorant (DCCO)

Forster's Tern (FOTE)

Great Blue Heron (GBHE)

Great Egret (GREG)

Mallard (MALL)

Sharp-shinned Hawk (SSHA)

Western Gull (WEGU)

White-tailed Kite (WTKI)

APPENDIX E.

Mean abundance of each species by habitat alliance per point, during the San Francisco Bay Area national parks inventory point counts, detections within 50m. Sample size of points given beneath habitat code.

Species		Habitat Alliance (>5 pts)*													Habitat Alliance (<5 pts)*								
		BA 44	BP 26	CB 114	DF 88	DS 12	EU 27	GR 63	LO 22	MP 9	RA 44	RW 50	TO 11	WI 97	AM 3	BE 1	BU 1	CH 1	FB 2	LU 3	RE 1	RU 1	SB 1
Acorn Woodpecker	ACWO	0.01			0.03				0.02		0.04	0.01											
Allen's Hummingbird	ALHU	0.2	0.45	0.18	0.27		0.45	0.02	0.12	0.04	0.36	0.11	0.09	0.36		0.67	0.33						0.33
American Goldfinch	AMGO	0.02	0.03	0.12	0.02		0.14	0.05		1.17	0.18			0.19								0.67	0.33
American Robin	AMRO	0.14	0.01		0.11		0.17	0.01	0.06	0.35	0.2	0.04	0.06	0.12									
Anna's Hummingbird	ANHU	0.02	0.05	0.08	0.05		0.08		0.24	0.17	0.06	0.01	0.06	0.08									
Ash-throated Flycatcher	ATFL	0.01		*			0.02				0.02			0.04									
Belted Kingfisher	BEKI	0.01			*									*									
Bewick's Wren	BEWR	0.05	0.31	0.18	0.23		0.27	0.06	0.24	0.78	0.18	0.05		0.14				0.33				0.33	1
Brown-headed Cowbird	BHCO	0.01		0.06	*	0.03	0.05	0.05	0.09	0.06	0.17			0.2									
Black-headed Grosbeak	BHGR	0.11		*	0.03		0.06		0.03		0.26			0.14			0.33						
Black Phoebe	BLPH	0.01		*					0.02		0.06	0.01		0.01									
Brewer's Blackbird	BRBL	0.01		0.02	*		0.04	0.07	0.02	0.39	0.11			0.16	0.33				0.17				
Brown Creeper	BRCR	0.13	0.21		0.07		0.07		0.14	0.22		0.17	0.39	0.01									
Band-tailed Pigeon	BTPI	0.04	0.03	0.01	0.03						0.07	0.09	0.06										
Black-throated Gray Warbler	BTYW	0.03							0.05			0.01											
Bullock's Oriole	BUOR													0.01									
Bushtit	BUSH	0.11		0.08	0.12		0.04		1.24		0.16	0.08		0.15									
California Towhee	CALT	0.11	0.04	0.06	0.11		0.11	0.02	0.08	0.11	0.11	0.01		0.11									
California Thrasher	CATH			0.02																			
Chestnut-backed Chickadee	CBCH	0.61	0.79	0.06	0.65		0.49		0.50	0.65	0.39	0.54	0.45	0.31		0.67	0.67						1.67
Chipping Sparrow	CHSP	0.01		0.01	*			0.02	0.08		0.01			*									
Common Yellowthroat	COYE			0.02				0.02		0.06	0.2			0.3									0.33
Downy Woodpecker	DOWO	0.02			0.01		0.01		0.20	0.06	0.11			0.03				0.33					
European Starling	EUST	0.05	0.01		0.01		0.71	0.03	0.09	0.11	0.07	0.03		0.07								1	
Golden-crowned Kinglet	GCKI	0.11		0.01	0.28				0.02			0.12	0.18										
Grasshopper Sparrow	GRSP			0.01				0.05	0.02									0.84					
Hairy Woodpecker	HAWO	0.05	0.08	*	0.05		0.12			0.22	0.06	0.01		0.04		0.33							
Hermit Thrush	HETH	0.05			0.03				0.03				0.06					0.33					

		Habitat Alliance (>5 pts)*														Habitat Alliance (<5 pts)*									
		BA 44	BP 26	CB 114	DF 88	DS 12	EU 27	GR 63	LO 22	MP 9	RA 44	RW 50	TO 11	WI 97	AM 3	BE 1	BU 1	CH 1	FB 2	LU 3	RE 1	RU 1	SB 1		
Species																									
Hermit Warbler	HEWA										0.01														
Horned Lark	HOLA					0.33		0.05								0.22									
House Finch	HOFI	0.02		0.03			0.17		0.36	0.06	0.03			0.03								0.33			
House Sparrow	HOSP							0.03			0.01			0.02											
Hutton's Vireo	HUVI	0.04	0.13	0.01	0.06		0.01		0.24	0.28	0.04	0.05		0.01											
Lark Sparrow	LASP				*			0.02																	
Lazuli Bunting	LAZB			0.01				0.01	0.03		0.01														
Lesser Goldfinch	LEGO			0.02																					
Marsh Wren	MAWR										0.01			0.08											
MacGillivray's Warbler	MGWA	0.01		*			0.01		0.02					0.01											
Mourning Dove	MODO	0.03	0.06	0.01	0.02		0.19				0.09	0.01		0.04											
Northern Mockingbird	NOMO			*																					
Nuttall's Woodpecker	NUWO	0.02																							
Nuttall's White-crowned Sparrow	NWCS			0.79	0.03	1.06		0.48	0.02	0.17	0.01			0.05					1.11	0.33	1.67				
Oak Titmouse	OATI	0.01																							
Orange-crowned Warbler	OCWA	0.07	0.04	0.08	0.14		0.04		0.08	0.04	0.29	0.03	0.03	0.13		0.33						0.33			
Oregon Junco	ORJU	0.29	0.18	0.01	0.28		0.31	0.02	0.56	0.28		0.15	0.18												
Olive-sided Flycatcher	OSFL	0.02			0.01		0.13				0.07			0.01											
Pine Siskin	PISI	0.01	0.31	*	0.03				0.02	0.17		0.01													
Pileated Woodpecker	PIWO	0.01			0.02				0.02				0.03												
Pacific-slope Flycatcher	PSFL	0.61	0.37	*	0.39		0.40		0.56	0.33	0.2	0.70	0.79	0.07		1	0.67								
Purple Finch	PUFI	0.08	0.28	0.06	0.15		0.40	0.03	0.09	0.17	0.05	0.05	0.03	0.03											
Pygmy Nuthatch	PYNU	0.03	0.35	0.05	0.01				0.11			0.04	0.06												
Red-breasted Nuthatch	RBNU		0.01		0.04				0.11			0.01													
Rufous-crowned Sparrow	RCSP			*																					
Rock Dove	RODO							0.01																	
Red-shafted Flicker	RSFL			0.01	0.02		0.05			0.11	0.07	0.01		0.02											
Red-winged Blackbird	RWBL			0.06	*			0.28			0.18			0.8											
Savannah Sparrow	SAVS			0.27		0.14		1.05	0.03					*	0.44					2					
Song Sparrow	SOSP	0.39	0.08	1.05	0.39	0.06	0.17	0.38	0.33	0.83	1.49	0.02		1.46		1.33	1		1.33		2.67	2.33			
Spotted Towhee	SPTO	0.08	0.5	0.46	0.42		0.17	0.05	0.71	0.04	0.08	0.13	0.03	0.09			0.33	0.33							
Steller's Jay	STJA	0.11	0.06	*	0.14		0.27		0.27		0.12	0.12	0.06	0.02				0.33							
Swainson's Thrush	SWTH	0.26	0.69	0.04	0.51		0.12		0.18	0.43	0.58	0.19		0.51		1.33	0.67					0.67			
Warbling Vireo	WAVI	0.2	0.01		0.08		0.05		0.15		0.26	0.14	0.21	0.18			0.67								

		Habitat Alliance (>5 pts)*													Habitat Alliance (<5 pts)*								
		BA 44	BP 26	CB 114	DF 88	DS 12	EU 27	GR 63	LO 22	MP 9	RA 44	RW 50	TO 11	WI 97	AM 3	BE 1	BU 1	CH 1	FB 2	LU 3	RE 1	RU 1	SB 1
Species																							
Western Bluebird	WEBL			0.01	0.01			0.01	0.03														
Western Kingbird	WEKI			*																			
Western Meadowlark	WEME							0.01															
Western Scrub-Jay	WESJ	0.04		0.12	0.09		0.11		0.70	0.22	0.11	0.07		0.15									1
Western Wood-Pewee	WEWP	0.05			0.01		0.05	0.01	0.06		0.12			0.02									
Wilson's Warbler	WIWA	0.56	0.9	0.09	0.59		0.33	0.01	0.30	0.09	0.73	0.29	0.12	0.68		1.67	1.33	0.33					1
Winter Wren	WIWR	0.4	0.41		0.27		0.18		0.09		0.06	0.35	0.42	0.02			0.33						
Wrentit	WREN	0.05	0.67	0.34	0.33		0.02		0.11	0.11	0.05	0.13		0.26				1					
Yellow Warbler	YWAR	0.01												0.02									

* mean abundance < 0.01

Habitat alliances: AM=European dunegrass; BA=California Bay; BE=boxelder; BP=bishop pine; BU=buckeye; CB=coyote brush; CH=chamise; DF=Douglas fir; DS=dune sagewort; EU=eucalyptus; FB=French broom; GR=annual grassland; LO=coast live oak; LU=yellow bush lupine; MP=Monterey pine; RA=red alder; RE=Pacific reedgrass; RU=rush; RW=coast redwood; SB=salmonberry; TO=tanoak; WI=willow.

APPENDIX F.

POINT COUNT SUMMARY DATABASE

The two appropriate point count databases (found in Supplement A) that can be used to make additional maps (such as species abundance maps) are:

PCABSUML50 - includes all data for the breeding species within 50m, excluding species censused poorly with the point count method (see *Methods: Statistical Analysis* above).

PCABSUMALL - includes all data for all species and all detections, inclusive of those detected within 50m, those detected greater than 50m, and those detected flying over the point count station.

Point count database fields explained.

YEAR = year in which point count data was collected at that station.

STATION = abbreviated transect name (4-letters)

SITE = point count station number within a given transect

UNIQUECODE = abbreviated transect name combined with station number

VISITS = number of census visits done at that point (1 - 3)

SW = bird diversity at that point (see *Methods: Statistical Analysis*)

SPECRICH = species richness at that point (see *Methods: Statistical Analysis*)

TOTINDIV = total number of individuals detected at that point.

MEAN_IND = average number of individuals detected at that point

HABITAT = habitat name

HAB = 2-letter habitat code

Y COOR = UTM north in NAD83

X COOR = UTM east in NAD83

GPS_PRECIS = precision of the point count station location. Coordinates were taken for most points, but had to be estimated for those points for which none could be taken (37 in total) in order to map approximate locations of these points and associated data. *PRECISE* = location of point in database is exact; *CLOSE* = location of point is very close (i.e., coordinates were able to be taken near the point but not at exact point); *ESTIMATE* = location of point is estimated, based on location of transect drawn on map.

SPECAB = multiple fields, detailing abundance of each species at each point (average per visit). Uses AOU 4-letter codes for each bird species, combined with "AB" for abundance. See table in Appendix C and Appendix D for species codes.

VEGETATION DATABASE

The appropriate tables/databases (Supplement A) that can be used to further evaluate vegetation within the parks are:

PRNS_UTM83 – database of all transect points and GPS coordinates in Nad83

PRNSSERIES – classification of all points including formation, alliance, and association

PRNSVEG1 – section of the vegetation relevé containing general habitat characteristics of the site including aspect, slope, presence/absence of water, # snags and logs and cover, with mean height and mean dbh of each vegetation stratum (tree, shrub and herb) estimated.

PRNSVEG2 – within each stratum: species composition and relative cover as a percent of total cover for that stratum. Excludes data collected in 1998 within Point Reyes National Seashore (see next) as a different methodology was used for those transects.

PORE97VEG2 - within each stratum: species composition and relative cover as a percent of total cover for that plot, not simply for that stratum. Volume was also taken into consideration. Collected differently than for rest of transects. Includes ABKE, BEVA, COCA, CTLA, LOOL, MRAN, MUHO, and UPOL.

PRESPCV1-same as PRNSVEG1 but includes only Presidio data

PRESPCV2-same as PRNSVEG2 but includes only Presidio data

PRNSVEGSUM – compilation of all Veg1 and Veg2 data presented by point. PRNSVEGCODS – list of all vegetation codes used in Veg1 and Veg2 databases. Includes common and scientific names, 4 letter Latin abbreviation, 6 letter USDA6 code, and sometimes a 4 letter common name code. Excludes data collected in 1998 within Point Reyes National Seashore (see next) as a different methodology was used for those transects.

PORE97VEGSUM - compilation of all Veg1 and Veg2 data presented by point, for transects where a modified vegetation protocol was used (see PORE97VEG2 above).

PRNSHABITATCODES – list of habitat classifications and their appropriate codes

Codes used in vegetation databases:

YEAR = year in which vegetation data were collected at that station.

STATION = abbreviated transect name (4-letters)

SITE = point count station number within a given transect

UNICODE (CODE) = abbreviated transect name combined with station number

HAB = 2-letter habitat code

Y COOR = UTM north in NAD83

X COOR = UTM east in NAD83

GPS UNIT = various units used to georeference points include:

PLGR = Park Service Plugger unit

Trimble = Park Service Trimble unit

Pro XR = Park Service Trimble unit used in 2000

GAR2+ = PRBO Garmin unit

GAR1997 and GarminII+ = PRBO Garmin units used in 1997 before selective availability

Estimate = location of point is estimated, based on location of transect drawn on map

No Location = unable to reference point either with GPS or map

FORMATION = general vegetation classification (Keeler-Wolf 1999).

ALLIANCE = more specific vegetation classification based on dominant species.

ASSOC = subset of the alliance classification

HERBCOV1 SHRUBCOV1 TREECOV1 = percentage of cover in dominant stratum

HERBCOV2 SHRUBCOV2 TREECOV2 = percentage of cover in secondary stratum

HERBRICH SHRUBRICH TREERICH = plant species richness within each stratum

ABLAH1 - VIMAH1 = plant species in alphabetical order and by stratum

APPENDIX G.

Species diversity, richness (cumulative and mean) and abundance indices for all stations censused during the San Francisco Bay Area national parks avian inventory, 1998-2000, detections within 50m.

Station	# points	# visits	Index of Abundance	Mean Diversity	Mean Species Richness	Cumulative Species Richness
ABKE	16	3	6.96	4.8	6.81	20
ANIS	12	1	10.33	3.55	3.83	18
ARHO	6	3	9.22	9.03	10.67	22
ATT	7	3	8.71	2.84	3.29	12
ATTG	7	3	3.29	1.96	2.57	7
ATTS	4	3	4.5	3.14	3.75	7
BEVA	16	3	7.81	8.46	10.31	36
BIP1	8	3	8.04	9.54	11.25	21
BIP2	8	3	7.54	9.57	11	19
BIP3	4	3	4.92	6.47	7	16
BJTR	15	3	2.96	4.71	5.2	22
BORT	25	3	5.05	6.89	7.8	25
BOTR	15	3	3.76	5.93	6.67	22
BVMT	11	3	5.48	1.95	8.82	25
CGEU	8	3	7.58	7.15	9.25	25
COCA	8	3	7	7.17	9.13	21
CRTR	15	3	3.42	3.73	4.33	12
CTLA	13	3	6.51	7.9	9.54	31
CTPA	14	3	7.14	7.13	8.93	25
DEGU	6	3	6.39	8.47	10	22
DUSC	7	3	2	1.72	2	6
EUMV	10	3	4.93	8.18	9.2	28
GERB	18	3	7.35	8.84	10.44	26
HORA	10	2	6.3	5.72	6.8	24
INRI	4	3	4.58	6.45	7.25	13
JACR	6	3	2.22	3.11	3.5	15
JEPS	6	3	6.72	8.59	9.67	21
LACR	18	3	7.32	9.28	10.94	35
LOOL	15	3	5.87	6.48	7.73	26
MCDU	12	3	3.33	2.48	3	9
MCTR	6	3	2.39	4.26	4.67	17
MEEU	2	3	7.17	8.27	9.5	12
MIRI	9	3	5.15	5.02	5.78	14
MOGU	15	3	5.78	7.42	8.67	29
MRAN	8	3	7.46	6.52	8.25	21
MTWI	10	3	7.27	8.75	10.4	27
MUHO	17	3	9.22	9.41	12.06	35
MWOT	15	3	3.96	5.6	6.4	24
OLGR	10	3	3.47	2.83	3.22	20
OPDS	12	3	1.28	1.32	1.5	4
OPTR	10	3	5.03	5.94	7	20

Station	# points	# visits	Index of Abundance	Mean Diversity	Mean Species Richness	Cumulative Species Richness
PAG5	4	3	4.75	4.7	6	15
PALO	13	3	6.74	8.92	10.15	28
PHES	9	3	1.59	2.8	3.11	12
PIGU	5	3	6.27	7.7	9	17
PRES	24	3	8.26	6.98	8.71	31
PRHN	15	3	3.6	2.68	3.27	8
PRHS	15	3	3.22	1.96	2.4	11
RATR	8	3	5.42	7.24	8.38	21
RECR	24	3	8.36	9.24	11.46	39
RITR	8	3	4.75	7.15	8	20
RODE	15	3	2.96	3.78	4.2	14
SPBP	10	3	3.67	5.74	6.3	21
STGU	15	3	4.33	6.15	7	29
STRA	15	3	3.93	6.12	6.87	30
SWRI	12	3	6.28	6	7.25	17
TEVA	14	3	9.81	9.75	12.29	38
TOMN	15	3	3.53	2.61	3.2	13
TOMS	15	3	3.2	3.09	3.6	16
UPOL	13	3	5.82	7	8.46	26
UPRT	10	3	7.2	8.52	9.9	24

SUPPLEMENT A.

Compact Disc containing vegetation, bird and GIS databases, including summaries of point count data in appropriate format for creating species abundance maps, and all vegetation data. December 2001.